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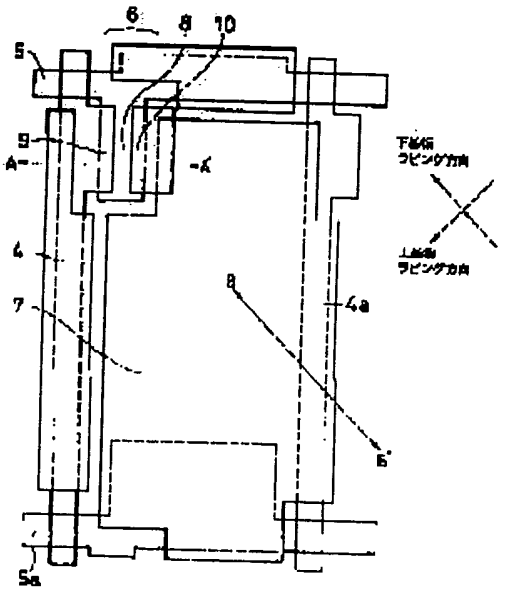
(54) ACTIVE MATRIX LIQUID CRYSTAL DISPLAY DEVICE

(57) Abstract:

PURPOSE: To provide an active matrix liquid crystal display device capable of improving contrast without reducing an opening ratio by preventing a lateral electric field from occurring between a picture element electrode and a signal line or scanning line and suppressing the occurrence of a reverse tilt area, and improving the contrast without reducing the opening ratio by generating the most part of the reverse tilt area at a wiring part shielded by a black matrix.

CONSTITUTION: This device is the active matrix liquid crystal display device in which the picture element electrode 7 is formed so as to traverse line width via an insulating layer at the upper part of the signal line 4a and the scanning line 5a setting a picture element corner in a direction to start rubbing as an intersection. and also, it is the one in which the picture element electrode 7 is formed up to the center of the line width via the insulating layer at the upper part of the signal line 4a and the scanning line 5a.



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CLAIMS

[Claim(s)]

[Claim 1] Two or more scanning lines formed in the line writing direction. Two or more signal lines formed in the direction of a train. The driver element formed in each intersection position of the aforementioned scanning line and the aforementioned signal line. The pixel electrode linked to each aforementioned driver element. The 1st substrate which has the orientation film in which orientation processing was carried out by rubbing in the front face on two or more aforementioned pixel electrode upper surface, Liquid crystal filled between the 2nd substrate which has the shading layer which covers portions other than the pixel electrode of the 1st substrate of the above, the counterelectrode which counters the aforementioned pixel electrode, and the orientation film in which orientation processing was carried out by rubbing in the front face on the aforementioned counterelectrode upper surface, and the 1st substrate of the above and the 2nd substrate of the above. It is the active-matrix liquid crystal display equipped with the above, and is characterized by being formed through an insulating layer so that the aforementioned pixel electrode may cross and cover the line breadth of one [at least] wiring of the scanning line equivalent to two sides of the start direction of the orientation processing by rubbing of the orientation film of the 1st substrate of the above, and a signal line.

[Claim 2] Two or more scanning lines formed in the line writing direction. Two or more signal lines formed in the direction of a train. The driver element formed in each intersection position of the aforementioned scanning line and the aforementioned signal line. The pixel electrode linked to each aforementioned driver element. The 1st substrate which has the orientation film in which orientation processing was carried out by rubbing in the front face on two or more aforementioned pixel electrode upper surface, Liquid crystal filled between the 2nd substrate which has the shading layer which covers portions other than the pixel electrode of the 1st substrate of the above, the counterelectrode which counters the aforementioned pixel electrode, and the orientation film in which orientation processing was carried out by rubbing in the front face on the aforementioned counterelectrode upper surface, and the 1st substrate of the above and the 2nd substrate of the above. It is the active-matrix liquid crystal display equipped with the above, and is characterized by being formed through an insulating layer so that the aforementioned pixel electrode may cover a part of one [at least] wiring of the scanning line equivalent to two sides of the start direction of the orientation processing by rubbing of the orientation film of the 1st substrate of the above, and a signal line.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the active-matrix liquid crystal display which can raise the contrast of display quality of image, without starting the active-matrix liquid crystal display which used TFT (Thin Film Transistor;TFT), diode; MIM (metal/insulator/metal), the varistor, etc. as a driver element, and reducing a numerical aperture especially.
[0002]
[Description of the Prior Art] As a conventional TFT type active-matrix liquid crystal display, there was display as shown in drawing 8 and drawing 9 . Drawing 8 is 1-pixel flat-surface explanatory drawing of the conventional active-matrix liquid crystal display, and drawing 9 is type section explanatory drawing of the D-D' portion of drawing 8 . As an active-matrix liquid crystal display is shown in drawing 9 , it consists of a TFT substrate 1, an opposite substrate 2, and liquid crystal 3, the TFT substrate 1 and the opposite substrate 2 confront each other at a fixed interval, and the gap of the TFT substrate 1 and the opposite substrate 2 is filled with liquid crystal 3.
[0003] The signal line 4 of the direction of a train (length) and the scanning line 5 of the direction of a line (width) are formed in the TFT substrate 1 in the shape of a matrix, and TFT (TFT) 6 which is a driver element, and the pixel electrode 7 which consists of a transparent conductor are formed in it at each intersection of a signal line 4 and the scanning line 5. And the gate electrode 8 of each TFT6 is connected to the common scanning line 5 for every line, the source electrode 9 is connected to the common signal line 4 for every train, and the drain electrode 10 is connected to the pixel electrode 7, and the orientation film 13 is formed so that the whole substrate may be covered further.
[0004] On the other hand, the black matrix 11 of a wrap sake is formed in an inferior surface of tongue in TFT6 formed in the TFT substrate 1, each wiring portion, and the crevice portion of the pixel electrode 7 and each wiring, the counterelectrode 12 which is a common electrode is formed in the bottom of it, and orientation film 13' is prepared in the opposite substrate 2 which consists of a translucency substrate so that the whole inferior surface of tongue may be worn further.
[0005] In order that the TFT substrate 1 and the opposite substrate 2 which were formed as mentioned above may make the orientation of the liquid crystal molecule carry out in the fixed direction with a fixed pre tilt angle to a substrate and may make display quality of image uniform, processing (rubbing processing) which, on the other hand, grinds the orientation film 13 and 13' against cloth, such as polyester, at ** is performed. Here, the direction of rubbing of the TFT substrate 1 is made into the direction ~~which goes to the upper left from the lower right of drawing 8~~ , and the direction of rubbing of the opposite substrate 2 is made into the direction which goes to the lower left from the upper right. And the TFT substrate 1 and the opposite substrate 2 are held so that the orientation film 13 and 13' may face mutually, and liquid crystal 3 is filled in the meantime.

counterelectrode of an opposite substrate in the shape of a stripe, the method (refer to JP,4-55819,A) of seeing by preparing an inclination in a pixel electrode edge, and enlarging the upper tilt angle, etc. are learned.

[0014] Moreover, as a method of making intensity of longitudinal direction electric field small, the method (refer to JP,1-266512,A and JP,4-49692,B) of enlarging distance between notching, the pixel electrode 7, and a signal line 4 for the edge of the pixel electrode 7, the method (refer to JP,3-177817,A) of choosing the direction of rubbing so that it may lap with the portion to which TFT has connected the reverse tilt field and it may be generated, etc. are learned. Since a drain electrode overlaps the method of choosing the latter direction of rubbing by reverse stagger type TFT at a gate electrode, longitudinal direction electric field use a bird clapper small on a gate electrode.

[0015] Extend the edge of the method (refer to JP,1-266512,A) of forming a black matrix, and the pixel electrode 7 to the lower part of a black matrix, deform the line breadth of a signal line further corresponding to area extension of the pixel electrode 7, make the extension generate a reverse tilt field as a method which is not conspicuous and carries out the generated reverse tilt field so that a reverse tilt field may be covered, and the method (refer to JP,2-13927,A) of forming a black matrix so that a reverse tilt field may be covered etc. is learned.

[0016]

[Problem(s) to be Solved by the Invention] Thus, it sets to the above-mentioned conventional active-matrix liquid crystal display. Although a reverse tilt field occurs by the longitudinal direction electric field between a signal line and a pixel electrode or between the scanning line and a pixel electrode, there is a trouble that contrast falls and there is the method of enlarging the above-mentioned conventional pre tilt angle as the solution at the time of un-choosing Effect of a certain thing with a certain amount of sufficient effect to a contrast improvement is not acquired. Moreover, by the method of choosing the direction of rubbing so that it may generate in the portion to which a reverse tilt field laps with a TFT portion, there was a trouble that generating of a reverse tilt field could be prevented only in a portion with the drain electrode of TFT.

[0017] Furthermore, by the method of cutting and lacking the pixel electrode edge as a method which is not conspicuous and carries out the reverse tilt field which is another conventional solution, and the method of making the edge of a pixel electrode correspond to deformation of a signal line, extending, making this extension generate a reverse tilt field, and covering by the black matrix, although improved, contrast had the trouble that the luminosity of an element fell, in order that a numerical aperture might decrease.

[0018] this invention aims at offering the active-matrix liquid crystal display which can prevent the fall of the contrast by the reverse tilt field, without having been accomplished in view of the above-mentioned actual condition, and decreasing the numerical aperture of an element.

[0019]

[Means for Solving the Problem] Invention according to claim 1 for solving the trouble of the above-mentioned conventional example Two or more scanning lines formed in the line writing direction, and two or more signal lines formed in the direction of a train, The driver element formed in each intersection position of the aforementioned scanning line and the aforementioned signal line, and the pixel electrode linked to each aforementioned driver element, The 1st substrate which has the orientation film in which orientation processing was carried out by rubbing in the front face on two or more aforementioned pixel electrode upper surface, The shading layer which covers portions other than the pixel electrode of the 1st substrate of the above, and the counterelectrode which counters the aforementioned pixel electrode, In the active-matrix liquid crystal display possessing the liquid crystal filled by the aforementioned counterelectrode upper surface between the 2nd substrate which has the orientation film in which orientation processing was carried out by rubbing in the front face, and the 1st substrate of the above and the 2nd substrate of the above It is characterized by being formed

[0006] Next, the drive method of the above-mentioned conventional active-matrix liquid crystal display is explained. If selection voltage (Vg, on) is impressed to one of the scanning line 5, TFT6 connected to the scanning line 5 will be in an ON state, the potential of the pixel electrode 7 will become equal to the potential of a signal line 4, and the data voltage currently outputted to the signal line 4 will be written in the pixel electrode 7. On the other hand, since the counterelectrode 12 is held at fixed voltage, by the potential difference of the data voltage and the counterelectrode 7 which were written in the pixel electrode 7, vertical electric field are built over the liquid crystal 3 inserted in between, the orientation state of liquid crystal 3 changes according to the intensity of this electric field, a light transmittance changes in connection with it, and image display is performed.

[0007] Since the data voltage written in the pixel electrode 7 is held while non-choosing voltage (Vg and off) is impressed until the following selection voltage (Vg, on) is impressed to the scanning line 5 that is, an active-matrix liquid crystal display can acquire high contrast compared with a simple matrix liquid crystal display.

[0008] However, in the above-mentioned conventional active-matrix liquid crystal display, in a non-selection period, the potential difference may be produced between the pixel electrode 7 and a signal line 4 or between the pixel electrode 7 and the scanning line 5, and longitudinal direction electric field may occur at the periphery of the pixel electrode 7. Depending on the part of the pixel electrode 7, this longitudinal direction electric field had the operation which makes reverse the direction of a tilt of a liquid crystal molecule, and as shown in drawing 8 , the reverse tilt field 20 which the direction of a tilt of a liquid crystal molecule reversed occurred, and they had become the cause of the fall of contrast, or a fall of a visual-sense property.

[0009] Here, the mechanism which the reverse tilt field (reverse tilt domain) 20 generates is concretely explained using cross-section explanatory drawing of drawing 9 . Since rubbing processing of the TFT substrate 1 is carried out, when there is no potential difference between the pixel electrode 7 and a signal line 4, orientation of the liquid crystal molecule near the substrate is uniformly carried out by pre tilt angle theta to the orientation side of the orientation film 13 of a substrate.

[0010] However, if the potential difference arises between the pixel electrode 7 and a signal line 4, as shown in drawing 9 , longitudinal direction electric field will occur so that the pixel electrode 7 and a signal line 4 may be connected. In the edge (a part for the lower right corner [Drawing 8] of the pixel electrode 7) of the pixel electrode 7 which corresponds in the rubbing start direction of the TFT substrate 1 especially, since longitudinal direction electric field which make the orientation of the direction of a tilt of a liquid crystal molecule carry out to the field of the normal pixel electrode 7 in the opposite direction of -theta, i.e., the direction, arise, the reverse tilt field 20 occurs into this portion. Since other fields and light transmittances differed from each other, the reverse tilt field 20 had the problem of reducing the contrast of a display pixel.

[0011] It is a problem peculiar to an active-matrix liquid crystal display, and this problem is the same even when diodes other than TFT, MIM, a varistor, etc. are used as a driver element.

[0012] The conventional method for preventing the fall of the contrast by the reverse tilt field is divided roughly into the method of preventing generating of a reverse tilt field, and the method which is not conspicuous and carries out it even if a reverse tilt field occurs. As a method of preventing generating of a reverse tilt field, there were a method of enlarging pre tilt angle theta and the method of making intensity of longitudinal direction electric field small.

[0013] first, as a method of enlarging a pre tilt angle The method [theta / pre tilt angle] using a large liquid crystal material (refer to electronic-intelligence communication society technical research report [electronic display]:EID 91-72 besides Sawada, and p1 (1991)), The method [theta / pre tilt angle] using a large orientation film (refer to National Technical Report Vol.38 No.3 besides Satani, and p54 (1992)), The method (EID 91-121 besides Nishiki, p35 (1991) reference) of forming the

through an insulating layer so that the aforementioned pixel electrode may cross and cover the line breadth of one [at least] wiring of the scanning line equivalent to two sides of the start direction of the orientation processing by rubbing of the orientation film of the 1st substrate of the above, and a signal line.

[0020] Invention according to claim 2 for solving the trouble of the above-mentioned conventional example Two or more scanning lines formed in the line writing direction, and two or more signal lines formed in the direction of a train, The driver element formed in each intersection position of the aforementioned scanning line and the aforementioned signal line, and the pixel electrode linked to each aforementioned driver element, The 1st substrate which has the orientation film in which orientation processing was carried out by rubbing in the front face on two or more aforementioned pixel electrode upper surface, The shading layer which covers portions other than the pixel electrode of the 1st substrate of the above, and the counterelectrode which counters the aforementioned pixel electrode, In the active-matrix liquid crystal display possessing the liquid crystal filled by the aforementioned counterelectrode upper surface between the 2nd substrate which has the orientation film in which orientation processing was carried out by rubbing in the front face, and the 1st substrate of the above and the 2nd substrate of the above It is characterized by being formed through an insulating layer so that the aforementioned pixel electrode may cover a part of one [at least] wiring of the scanning line equivalent to two sides of the start direction of the orientation processing by rubbing of the orientation film of the 1st substrate of the above, and a signal line.

[0021]

[Function] Since according to invention according to claim 1 it is considering as the active-matrix liquid crystal display with which the pixel electrode was formed through the insulating layer so that the line breadth of one [at least] wiring of the scanning line of two sides which hits in the rubbing start direction of the orientation film of the 1st substrate, and a signal line may be crossed and wiring may be covered The line of electric force generated between a pixel electrode, a signal line, or the scanning line The contrast of a display pixel can be raised without not generating lateral electric field, being able to prevent generating of a reverse tilt field, and reducing a numerical aperture into liquid crystal, since termination is carried out at right angles to the field which emitted from the upper surface of a signal line or the scanning line, and the pixel electrode carried out.

[0022] Since according to invention according to claim 2 it is considering as the active-matrix liquid crystal display with which the pixel electrode was formed through the insulating layer so that a part of one [at least] wiring of the scanning line of two sides which hits in the rubbing start direction of the orientation film of the 1st substrate, and a signal line may be covered Although a reverse tilt field occurs by the longitudinal direction electric field between a pixel electrode, the scanning line, or a signal line Most reverse tilt fields to generate serve as the upper part of the scanning line or a signal line, and since it is covered by the shading layer formed in the 2nd substrate, the influence on the display screen can raise the contrast of a display pixel, without reducing the next door of a small potato, and a numerical aperture extremely.

[0023]

[Example] It explains referring to a drawing about one example of this invention. Drawing 1 is flat-surface explanatory drawing by the side of the TFT substrate of the active-matrix liquid crystal display concerning one example of this invention, drawing 2 is cross-section explanatory drawing of the A-A' portion of drawing 1 , and drawing 3 is type section explanatory drawing of the B-B' portion of drawing 1 . In addition, the portion which takes the same composition as drawing 8 and drawing 9 is explained using the same sign.

[0024] The active-matrix liquid crystal display of this example consists of liquid crystal 3 with which it inserted and filled up between the TFT substrate 1 of the bottom possessing the TFT (TFT) which

performs ON/OFF which is not penetrated [transparency /] and a signal line, and the scanning line, the opposite substrate 2 of the top possessing the counterelectrode which are a black matrix and a common electrode, and both substrates, as shown in drawing 3 . [of each pixel]

[0025] Furthermore, each part of the active-matrix liquid crystal display of this example is explained concretely. TFT 6 which a signal line 4 and the scanning line 5 are formed in the upper surface of glass-substrate 1' of the TFT substrate 1 in the shape of a matrix through insulating-layer 15', and is a driver element at each intersection of a signal line 4 and the scanning line 5 (TFT), The pixel electrode 7 of the transparent conductor which consists of indium tin oxide (ITO) etc. is formed, the gate electrode 8 of each TFT6 is connected to the common scanning line 5 for every line, the source electrode 9 is connected to the common signal line 4 for every train, and the drain electrode 10 is connected to the pixel electrode 7 of each pixel. Furthermore, the orientation film 13 is formed so that the whole upper surface may be worn, and in drawing 1 , rubbing processing is performed toward the upper left from the lower right.

[0026] The black matrix 11 or light filter (not shown) of a wrap sake is formed in the undersurface of glass-substrate 2' of the opposite substrate 2 in the wiring portions of TFT6 formed in the TFT substrate 1 and a signal line 4, and the scanning line 5, a counterelectrode 12 is formed in the bottom, orientation film 13' is prepared so that the whole undersurface may be worn further, and it succeeds in rubbing processing toward the lower left from the upper right of drawing 1 .

[0027] Moreover, TFT6 of each pixel in the TFT substrate 1 The scanning line 5 and the scanning line 5 which consist of metals, such as chromium (Cr), on glass-substrate 1' of the TFT substrate 1 as shown in drawing 1 and drawing 2 , and the really cast gate electrode 8, The gate insulating layer 15 which consists of a silicon dioxide (SiO2), and the semiconductor barrier layer 14 which consists of an amorphous silicon (a-Si) etc., The up insulating layer 16 which consists of silicon nitride (SiNx), and the source electrode 9 and the drain electrode 10 which consists of the semiconductor film with which the impurity was added have reverse stagger type structure by which the laminating was carried out one by one.

[0028] And the signal line 4 which consists of the aluminum (aluminum) which connects with the source electrode 9 through the layer insulation layers 17, such as a polyimide, is formed, further, the laminating of the layer insulation layers 18, such as a polyimide, is carried out, the pixel electrode 7 which consists of the indium tin oxide (ITO) which connects with the drain electrode 10 through opening prepared in this layer insulation layer 18 is formed, and it has the composition that the laminating of the orientation film 13 was carried out on this.

[0029] Moreover, although the driver element is set to TFT (TFT) in this example, you may use not only TFT but diode, MIM, a varistor, etc.

[0030] And the configuration of the pixel electrode 7 which is the feature portion of this example is formed so that the upper part of the signal line 4 of two sides which adjoins each other among four sides of the quadrilateral formed by two signal lines 4 and the two scanning lines 5 surrounding the pixel electrode 7, and the scanning line 5 may be covered. Here, in this example, two adjacent sides covered by the pixel electrode 7 may be two sides which make the pixel corner of the rubbing start direction an intersection. That is, as shown in drawing 1 , the pixel electrode 7 is formed so that it may lap with the upper part of signal-line 4a which adjoins the right-hand side of a pixel, and scanning-line 5a which adjoins the pixel bottom, except for a TFT portion, the line breadth of signal-line 4a and scanning-line 5a is crossed especially, line breadth is covered, and the pixel electrode 7 is extended at the lower right portion of the pixel which is the rubbing start direction, and it forms.

[0031] Especially, in this example, the soffit of the pixel electrode 7 is formed so that it may come below scanning-line 5a in drawing 1 so that the right end of the pixel electrode 7 may become on the right of signal-line 4a in drawing 1 so that the line breadth of signal-line 4a except TFT6 portion and

scanning-line 5a may be completely covered by the pixel electrode 7.
[0032] Moreover, [near TFT6], the right end of the pixel electrode 7 is extended and formed to the center of the upper part of signal-line 4a, and the soffit is extended and formed to the center of the upper part of scanning-line 5a. Since TFT6 portion has a level difference, this is for preventing pixel electrode 7 adjoining comrades connecting too hastily. Similarly, the amount of [of signal-line 4a and scanning-line 5a] intersection has also prepared minute notching as shown in drawing 1 , in order to prevent pixel electrode 7 adjoining comrades connecting too hastily, since a level difference becomes large. Since this notching portion is small, the influence on a numerical aperture is small.
[0033] Here, the electric field of the active-matrix liquid crystal display of this example and the orientation of liquid crystal are explained using type section explanatory drawing of drawing 3 . The reverse tilt field to which contrast is reduced is produced by the longitudinal direction electric field between a signal line 4 or the scanning line 5, and the pixel electrode 7, and generating in a corner which corresponds in the rubbing start direction of a pixel especially is known.
[0034] Since the pixel electrode 7 is extended even to the upper part of signal-line 4a which shares the corner of the rubbing start direction, and scanning-line 5a in this example, and it forms further so that the line breadth of signal-line 4a and scanning-line 5a may be covered, The line of electric force produced in the potential difference of signal-line 4a or scanning-line 5a, and the pixel electrode 7 Since it emits from the upper surface of signal-line 4a or scanning-line 5a and is made perpendicular termination on the inferior surface of tongue of the pixel electrode 7 Contrast can be raised without being able to prevent generating of a reverse tilt field and reducing a numerical aperture by this, into liquid crystal 3, without generating lateral electric field.
[0035] Next, the manufacture method of the active-matrix liquid crystal display of this example is explained using process cross-section explanatory drawing of drawing 4 (a) - (d), and drawing 5 (e) and (f). First, on substrate 1' of the TFT substrate 1 which consists of glass, a quartz, a ceramic, etc., film deposition of the chromium (Cr) is carried out by the sputtering method, patterning is carried out by photo lithography and etching, and the gate electrode 8 and the scanning line 5 of TFT6 are formed (refer to drawing 4 (a)).
[0036] Next, SiO2 It deposits and the gate insulating layer 15 is formed. The gate insulating layer 15 functions also as insulating-layer 15' of the intersection of the scanning line 5 and a signal line 4. And the amorphous silicon (a-Si) as a semiconductor barrier layer 14 is deposited, and it is SiNx as an up insulating layer 16 on it. It deposits, and the up insulating layer 16 is formed so that patterning may be carried out by photo lithography and etching and the gate electrode 8 may be countered (refer to drawing 4 (b)).
[0037] Film deposition of the n+a-Si which moreover added the impurity is carried out, patterning of an n+a-Si layer and the a-Si layer is carried out continuously, and the source electrode 9, the drain electrode 10, and the semiconductor barrier layer 14 are formed (refer to drawing 4 (c)). In addition, in order to reduce contact resistance with a signal line 4 or the pixel electrode 7, you may prepare barrier metal, such as a tungsten (W) and titanium (Ti), in the upper part of the source electrode 9 and the drain electrode 10.
[0038] And the laminating of the layer insulation layer 17 which consists of a silicon dioxide, silicon nitride, or a polyimide is carried out, the contact hole for connecting with the layer insulation layer 17 at the source electrode 9 is formed, next film deposition of the aluminum (aluminum) is carried out, it carries out patterning, and a signal line 4 is formed. In order to prevent that the pixel electrode 7 formed on it is disconnected with the level difference of the pattern edge section of a signal line 4 by etching which forms a signal line 4, it is desirable to perform taper etching of 45 degrees or more, and to make loose the level difference by the signal line 4 (refer to drawing 4 (d)).
[0039] And film deposition of a silicon dioxide, silicon nitride, or the polyimide is carried out, the

contact hole for connecting the pixel electrode 7 and the drain electrode 10 is formed, and the layer insulation layers 17 and 18 are formed. It is desirable to perform taper etching of 45 degrees or more so that ITO as a pixel electrode 7 formed in the layer insulation layer 18 upper part may carry out film deposition to a hole pars basilaris ossis occipitalis enough and may not cause an open circuit by etching of contact hole formation.

[0040] Furthermore, so that film deposition of the ITO as a pixel electrode 7 may be carried out and the area of the pixel electrode 7 may be extended to the pixel lower right portion which is the rubbing start direction on it except for a part for the intersection of signal-line 4a and scanning-line 5a Patterning is carried out so that the upper part with scanning-line 5a which adjoins signal-line 4a which adjoins the right-hand side of the pixel electrode 7 in drawing 1 , and the bottom may be covered, and the pixel electrode 7 is formed (refer to drawing 5 (e)).

[0041] And on it, a polyimide is applied, an orientation film is formed, rubbing processing is performed and the TFT substrate 1 is formed (refer to drawing 5 (f)). And between the opposite substrates 2 formed independently, restoration maintenance of the liquid crystal is carried out, it fixes, and an active-matrix liquid crystal display is formed in it.

[0042] Besides the material used by this example, moreover, as a material of the gate electrode 8 of TFT Metals other than chromium (Cr), such as aluminum (aluminum), a tantalum (Ta), and molybdenum (Mo), as a material of the gate insulating layer 15 The metallic oxide of silicon nitride (SiNx) and a gate electrode other than a silicon dioxide (SiO2) again as a material of the semiconductor barrier layer 14 Besides a-Si, CdSe, CdS and Te, PbTe, and polycrystal silicon (poly-Si) as the material of the up insulating layer 16 -- SiNx others -- SiO2 as the material of the pixel electrode 7 -- the tin oxide and a zinc oxide -- as the material of the layer insulation layers 17 and 18 -- everything but a polyimide -- SiO2 and SiNx etc. -- you may use

[0043] According to the active-matrix liquid crystal display of this example, the pixel electrode 7 is extended in the rubbing start direction. Since it is made to cover the line breadth of signal-line 4a of a portion, and scanning-line 5a which forms the pixel electrode 7 in the upper part of signal-line 4a which makes the pixel corner of the rubbing start direction an intersection, and scanning-line 5a, and a reverse tilt field tended to generate by the pixel electrode 7 Since generating of the longitudinal direction electric field in the pixel corner of the rubbing start direction leading to a reverse tilt field is suppressed and the area of the pixel electrode 7 is not reduced further, There is an effect which can prevent generating of a reverse tilt field and the fall of the contrast by it without reducing a numerical aperture.

[0044] Next, it explains, referring to drawing 6 and drawing 7 about another example concerning this example. Drawing 6 is flat-surface explanatory drawing of the active-matrix liquid crystal display of another example, and drawing 7 is type section explanatory drawing of the C-C' portion of drawing 6 . In addition, the same sign is attached and explained about the portion which takes the same composition as drawing 1 and drawing 3 .

[0045] Another active-matrix liquid crystal display of an example is extended and formed even in the center of the upper part of wiring of signal-line 4a and scanning-line 5a in which the pixel electrode 7 makes the pixel corner of the rubbing start direction an intersection with the almost same composition as the active-matrix liquid crystal display of the 1st example. It is the active-matrix liquid crystal display with which the pattern edge at the right end of the pixel electrode 7 was formed to the center of the upper part of signal-line 4a, and the pattern edge of the soffit of the pixel electrode 7 was specifically formed to the center of the upper part of scanning-line 5a.

[0046] It is made to form the edge of the pixel electrode 7 in the upper part of wiring of two sides which make an intersection the corner (here lower right) of the rubbing start direction which a reverse tilt field generates at least among the signal lines 4 and the scanning lines 5 which accomplish four

sides surrounding the pixel electrode 7, i.e., signal-line 4a, and scanning-line 5a in piles. Furthermore, as shown in drawing 6 , it is also possible three sides or to pile up four sides of edges on all. The lap width of face of a signal line 4 or the scanning line 5, and the pixel electrode 7 is set to 5 micrometers or more, and if it is 10 micrometers or more, it is more desirable.

[0047] The orientation of the electric field in another example and liquid crystal is explained using drawing 7 . In the another example, at least, since the edge at the right end of the pixel electrode 7 is formed in the upper part of signal-line 4a and the edge of the soffit of the pixel electrode 7 is formed in the upper part of scanning-line 5a in drawing 6 , as shown in drawing 7 , longitudinal direction electric field occur between the pixel electrode 7, signal-line 4a, or scanning-line 5a, and the reverse tilt field which the orientation of liquid crystal reverses by it is also generated. However, since most generated reverse tilt fields are equivalent to the upper part of signal-line 4a or scanning-line 5a, it is covered by the black matrix 11 prepared in the opposite substrate 2, and can suppress the fall of the contrast of the display screen very small.

[0048] Moreover, since the crevice out of which the light of the back light arranged at the liquid crystal panel tooth back leaks and comes is almost lost when the pattern edge of the pixel electrode 7 is formed in all the wiring sections surrounding the pixel electrode 7 of four sides in piles, the formation part of the black matrix of an opposite substrate can be limited only to the pixel corner of the rubbing start direction which a reverse tilt field generates.

[0049] The inside of the signal line 4 and the scanning line 5 surrounding another active-matrix liquid crystal display ****** of an example, and the pixel electrode 7, Since the pattern edge of the pixel electrode 7 is formed even in the center of the upper part of signal-line 4a and scanning-line 5a which makes the pixel corner of the rubbing start direction an intersection in piles at least The reverse tilt field produced by the longitudinal direction electric field between a signal line 4 or the scanning line 5, and the pixel electrode 7 There is an effect which can make the bad influence to contrast small without the most serving as the upper part of signal-line 4a or scanning-line 5a, being covered by the black matrix 11 prepared in the opposite substrate 2, and spoiling a numerical aperture.

[0050]

[Effect of the Invention] Since according to invention according to claim 1 it is considering as the active-matrix liquid crystal display with which the pixel electrode was formed through the insulating layer so that the line breadth of one [at least] wiring of the scanning line of two sides which hits in the rubbing start direction of the orientation film of the 1st substrate, and a signal line may be crossed and wiring may be covered The line of electric force generated between a pixel electrode, a signal line, or the scanning line Since termination is carried out at right angles to the field which emitted from the upper surface of a signal line or the scanning line, and the pixel electrode carried out It is effective in the ability to raise the contrast of a display pixel, without not generating lateral electric field, being able to prevent generating of a reverse tilt field, and reducing a numerical aperture into liquid crystal.

[0051] Since according to invention according to claim 2 it is considering as the active-matrix liquid crystal display with which the pixel electrode was formed through the insulating layer so that a part of one [at least] wiring of the scanning line of two sides which hits in the rubbing start direction of the orientation film of the 1st substrate, and a signal line may be covered Although a reverse tilt field occurs by the longitudinal direction electric field between a pixel electrode, the scanning line, or a signal line Since it is covered by the shading layer which most reverse tilt fields to generate became the upper part of the scanning line or a signal line, and was formed in the 2nd substrate The effect that the contrast of a display pixel can be raised has the influence on the display screen, without reducing the next door of a small potato, and a numerical aperture extremely.

[Translation done.]

* NOTICES *

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TECHNICAL FIELD

[Industrial Application] this invention relates to the active-matrix liquid crystal display which can raise the contrast of display quality of image, without starting the active-matrix liquid crystal display which used TFT (Thin Film Transistor;TFT), diode, MIM (metal/insulator/metal), the varistor, etc. as a driver element, and reducing a numerical aperture.especially.

[Translation done.]

PRIOR ART

[Description of the Prior Art] As a conventional TFT type active-matrix liquid crystal display, there was display as shown in drawing 8 and drawing 9 . Drawing 8 is 1-pixel flat-surface explanatory drawing of the conventional active-matrix liquid crystal display, and drawing 9 is type section explanatory drawing of the D-D' portion of drawing 8 . As an active-matrix liquid crystal display is shown in drawing 9 , it consists of a TFT substrate 1, an opposite substrate 2, and liquid crystal 3, the TFT substrate 1 and the opposite substrate 2 confront each other at a fixed interval, and the gap of the TFT substrate 1 and the opposite substrate 2 is filled with liquid crystal 3.

[0003] The signal line 4 of the direction of a train (length) and the scanning line 5 of the direction of a line (width) are formed in the TFT substrate 1 in the shape of a matrix, and TFT (TFT) 6 which is a driver element, and the pixel electrode 7 which consists of a transparent conductor are formed in it at each intersection of a signal line 4 and the scanning line 5. And the gate electrode 8 of each TFT6 is connected to the common scanning line 5 for every line, the source electrode 9 is connected to the common signal line 4 for every train, and the drain electrode 10 is connected to the pixel electrode 7, and the orientation film 13 is formed so that the whole substrate may be covered further.

[0004] On the other hand, the black matrix 11 of a wrap sake is formed in an inferior surface of tongue in TFT6 formed in the TFT substrate 1, each wiring portion, and the crevice portion of the pixel electrode 7 and each wiring, the counterelectrode 12 which is a common electrode is formed in the bottom of it, and orientation film 13' is prepared in the opposite substrate 2 which consists of a translucency substrate so that the whole inferior surface of tongue may be worn further.

[0005] In order that the TFT substrate 1 and the opposite substrate 2 which were formed as mentioned above may make the orientation of the liquid crystal molecule carry out in the fixed direction with a fixed pre tilt angle to a substrate and may make display quality of image uniform, processing (rubbing processing) which, on the other hand, grinds the orientation film 13 and 13' against cloth, such as polyester, at ** is performed. Here, the direction of rubbing of the TFT substrate 1 is made into the direction which goes to the upper left from the lower right of drawing 8 , and the direction of rubbing of the opposite substrate 2 is made into the direction which goes to the lower left from the upper right. And the TFT substrate 1 and the opposite substrate 2 are held so that the orientation film 13 and 13' may face mutually, and liquid crystal 3 is filled in the meantime.

[0006] Next, the drive method of the above-mentioned conventional active-matrix liquid crystal display is explained. If selection voltage (Vg, on) is impressed to one of the scanning line 5, TFT6 connected to the scanning line 5 will be in an ON state, the potential of the pixel electrode 7 will become equal to the potential of a signal line 4, and the data voltage currently outputted to the signal line 4 will be written in the pixel electrode 7. On the other hand, since the counterelectrode 12 is held at fixed voltage, by the potential difference of the data voltage and the counterelectrode 7 which were written in the pixel electrode 7, vertical electric field are built over the liquid crystal 3 inserted in

between, the orientation state of liquid crystal 3 changes according to the intensity of this electric field, a light transmittance changes in connection with it, and image display is performed.

[0007] Since the data voltage written in the pixel electrode 7 is held while non-choosing voltage (Vg and off) is impressed until the following selection voltage (Vg, on) is impressed to the scanning line 5 that is, an active-matrix liquid crystal display can acquire high contrast compared with a simple matrix liquid crystal display.

[0008] However, in the above-mentioned conventional active-matrix liquid crystal display, in a non-selection period, the potential difference may be produced between the pixel electrode 7 and a signal line 4 or between the pixel electrode 7 and the scanning line 5, and longitudinal direction electric field may occur at the periphery of the pixel electrode 7. Depending on the part of the pixel electrode 7, this longitudinal direction electric field had the operation which makes reverse the direction of a tilt of a liquid crystal molecule, and as shown in drawing 8 , the reverse tilt field 20 which the direction of a tilt of a liquid crystal molecule reversed occurred, and they had become the cause of the fall of contrast, or a fall of a visual-sense property.

[0009] Here, the mechanism which the reverse tilt field (reverse tilt domain) 20 generates is concretely explained using cross-section explanatory drawing of drawing 9 . Since rubbing processing of the TFT substrate 1 is carried out, when there is no potential difference between the pixel electrode 7 and a signal line 4, orientation of the liquid crystal molecule near the substrate is uniformly carried out by pre tilt angle theta to the orientation side of the orientation film 13 of a substrate.

[0010] However, if the potential difference arises between the pixel electrode 7 and a signal line 4, as shown in drawing 9 , longitudinal direction electric field will occur so that the pixel electrode 7 and a signal line 4 may be connected. In the edge (a part for the lower right corner [Drawing 8] of the pixel electrode 7) of the pixel electrode 7 which corresponds in the rubbing start direction of the TFT substrate 1 especially, since longitudinal direction electric field which make the orientation of the direction of a tilt of a liquid crystal molecule carry out to the field of the normal pixel electrode 7 in the opposite direction of -theta, i.e., the direction, arise, the reverse tilt field 20 occurs into this portion. Since other fields and light transmittances differed from each other, the reverse tilt field 20 had the problem of reducing the contrast of a display pixel.

[0011] It is a problem peculiar to an active-matrix liquid crystal display, and this problem is the same even when diodes other than TFT, MIM, a varistor, etc. are used as a driver element.

[0012] The conventional method for preventing the fall of the contrast by the reverse tilt field is divided roughly into the method of preventing generating of a reverse tilt field, and the method which is not conspicuous and carries out it even if a reverse tilt field occurs. As a method of preventing generating of a reverse tilt field, there were a method of enlarging pre tilt angle theta and the method of making intensity of longitudinal direction electric field small.

[0013] first, as a method of enlarging a pre tilt angle The method [theta / pre tilt angle] using a large liquid crystal material (refer to electronic-intelligence communication society technical research report [electronic display]:EID 91-72 besides Sawada, and p1 (1991)), The method [theta / pre tilt angle] using a large orientation film (refer to National Technical Report Vol.38 No.3 besides Satani, and p54 (1992)), The method (EID 91-121 besides Nishiki, p35 (1991) reference) of forming the counterelectrode of an opposite substrate in the shape of a stripe, the method (refer to JP,4-55819,A) of seeing by preparing an inclination in a pixel electrode edge, and enlarging the upper tilt angle, etc. are learned.

[0014] Moreover, as a method of making intensity of longitudinal direction electric field small, the method (refer to JP,1-266512,A and JP,4-49692,B) of enlarging distance between notching, the pixel electrode 7, and a signal line 4 for the edge of the pixel electrode 7, the method (refer to JP,3-177817,A) of choosing the direction of rubbing so that it may lap with the portion to which TFT

has connected the reverse tilt field and it may be generated, etc. are learned. Since a drain electrode overlaps the method of choosing the latter direction of rubbing by reverse stagger type TFT at a gate electrode, longitudinal direction electric field use a bird clapper small on a gate electrode.

[0015] Extend the edge of the method (refer to JP,1-266512,A) of forming a black matrix, and the pixel electrode 7 to the lower part of a black matrix, deform the line breadth of a signal line further corresponding to area extension of the pixel electrode 7, make the extension generate a reverse tilt field as a method which is not conspicuous and carries out the generated reverse tilt field so that a reverse tilt field may be covered, and the method (refer to JP,2-13927,A) of forming a black matrix so that a reverse tilt field may be covered etc. is learned.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] In invention according to claim 1, it is considering as the active-matrix liquid crystal display with which the pixel electrode was formed through the insulating layer so that the line breadth of one [at least] wiring of the scanning line of two sides which hits in the rubbing start direction of the orientation film of the 1st substrate, and a signal line might be crossed and wiring might be covered. Therefore, the line of electric force generated between a pixel electrode, a signal line, or the scanning line is effective in the ability to be able to raise the contrast of a display pixel, without not generating lateral electric field, being able to prevent generating of a reverse tilt field, and reducing a numerical aperture into liquid crystal, since termination is carried out at right angles to the field which emitted from the upper surface of a signal line or the scanning line, and the pixel electrode carried out.

[0051] In invention according to claim 2, it is considering as the active-matrix liquid crystal display with which the pixel electrode was formed through the insulating layer so that a part of one [at least] wiring of the scanning line of two sides which hits in the rubbing start direction of the orientation film of the 1st substrate, and a signal line might be covered. Therefore, although a reverse tilt field occurs by the longitudinal direction electric field between a pixel electrode, the scanning line, or a signal line, most reverse tilt fields generate serve as the upper part of the scanning line or a signal line, and since it is covered by the shading layer formed in the 2nd substrate, the effect that the contrast of a display pixel can raise has the influence on the display screen, without reducing the next door of a small potato, and a numerical aperture extremely.

[Translation done.]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS OPERATION EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

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MEANS

[Means for Solving the Problem] Invention according to claim 1 for solving the trouble of the above-mentioned conventional example Two or more scanning lines formed in the line writing direction, and two or more signal lines formed in the direction of a train, The driver element formed in each intersection position of the aforementioned scanning line and the aforementioned signal line, and the pixel electrode linked to each aforementioned driver element, The 1st substrate which has the orientation film in which orientation processing was carried out by rubbing in the front face on two or more aforementioned pixel electrode upper surface, The shading layer which covers portions other than the pixel electrode of the 1st substrate of the above, and the counterelectrode which counters the aforementioned pixel electrode, In the active-matrix liquid crystal display possessing the liquid crystal filled by the aforementioned counterelectrode upper surface between the 2nd substrate which has the orientation film in which orientation processing was carried out by rubbing in the front face, and the 1st substrate of the above and the 2nd substrate of the above It is characterized by being formed through an insulating layer so that the aforementioned pixel electrode may cross and cover the line breadth of one [at least] wiring of the scanning line equivalent to two sides of the start direction of the orientation processing by rubbing of the orientation film of the 1st substrate of the above, and a signal line.

[0020] Invention according to claim 2 for solving the trouble of the above-mentioned conventional example Two or more scanning lines formed in the line writing direction, and two or more signal lines formed in the direction of a train, The driver element formed in each intersection position of the aforementioned scanning line and the aforementioned signal line, and the pixel electrode linked to each aforementioned driver element, The 1st substrate which has the orientation film in which orientation processing was carried out by rubbing in the front face on two or more aforementioned pixel electrode upper surface, The shading layer which covers portions other than the pixel electrode of the 1st substrate of the above, and the counterelectrode which counters the aforementioned pixel electrode, In the active-matrix liquid crystal display possessing the liquid crystal filled by the aforementioned counterelectrode upper surface between the 2nd substrate which has the orientation film in which orientation processing was carried out by rubbing in the front face, and the 1st substrate of the above and the 2nd substrate of the above It is characterized by being formed through an insulating layer so that the aforementioned pixel electrode may cover a part of one [at least] wiring of the scanning line equivalent to two sides of the start direction of the orientation processing by rubbing of the orientation film of the 1st substrate of the above, and a signal line.

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OPERATION

[Function] In invention according to claim 1, it is considering as the active-matrix liquid crystal display with which the pixel electrode was formed through the insulating layer so that the line breadth of one [at least] wiring of the scanning line of two sides which hits in the rubbing start direction of the orientation film of the 1st substrate, and a signal line might be crossed and wiring might be covered. Therefore, the line of electric force generated between a pixel electrode, a signal line, or the scanning line can raise the contrast of a display pixel, without not generating lateral electric field, being able to prevent generating of a reverse tilt field, and reducing a numerical aperture into liquid crystal, since termination is carried out at right angles to the field which emitted from the upper surface of a signal line or the scanning line, and the pixel electrode carried out.
[0022] In invention according to claim 2, it is considering as the active-matrix liquid crystal display with which the pixel electrode was formed through the insulating layer so that a part of one [at least] wiring of the scanning line of two sides which hits in the rubbing start direction of the orientation film of the 1st substrate, and a signal line might be covered. Therefore, although a reverse tilt field occurs by the longitudinal direction electric field between a pixel electrode, the scanning line, or a signal line, most reverse tilt fields to generate serve as the upper part of the scanning line or a signal line, and since it is covered by the shading layer formed in the 2nd substrate, the influence on the display screen can raise the contrast of a display pixel, without reducing the next door of a small potato, and a numerical aperture extremely.

[Translation done.]

EXAMPLE

[Example] It explains referring to a drawing about one example of this invention. Drawing 1 is flat-surface explanatory drawing by the side of the TFT substrate of the active-matrix liquid crystal display concerning one example of this invention, drawing 2 is cross-section explanatory drawing of the A-A' portion of drawing 1 , and drawing 3 is type section explanatory drawing of the B-B' portion of drawing 1 . In addition, the portion which takes the same composition as drawing 8 and drawing 9 is explained using the same sign.

[0024] The active-matrix liquid crystal display of this example consists of liquid crystal 3 with which it inserted and filled up between the TFT substrate 1 of the bottom possessing the TFT (TFT) which performs ON/OFF which is not penetrated [transparency /] and a signal line, and the scanning line, the opposite substrate 2 of the top possessing the counterelectrode which are a black matrix and a common electrode, and both substrates, as shown in drawing 3 . [of each pixel]

[0025] Furthermore, each part of the active-matrix liquid crystal display of this example is explained concretely. TFT 6 which a signal line 4 and the scanning line 5 are formed in the upper surface of glass-substrate 1' of the TFT substrate 1 in the shape of a matrix through insulating-layer 15', and is a driver element at each intersection of a signal line 4 and the scanning line 5 (TFT), The pixel electrode 7 of the transparent conductor which consists of indium tin oxide (ITO) etc. is formed, the gate electrode 8 of each TFT6 is connected to the common scanning line 5 for every line, the source electrode 9 is connected to the common signal line 4 for every train, and the drain electrode 10 is connected to the pixel electrode 7 of each pixel. Furthermore, the orientation film 13 is formed so that the whole upper surface may be worn, and in drawing 1 , rubbing processing is performed toward the upper left from the lower right.

[0026] The black matrix 11 or light filter (not shown) of a wrap sake is formed in the undersurface of glass-substrate 2' of the opposite substrate 2 in the wiring portions of TFT6 formed in the TFT substrate 1 and a signal line 4, and the scanning line 5, a counterelectrode 12 is formed in the bottom, orientation film 13' is prepared so that the whole undersurface may be worn further, and it succeeds in rubbing processing toward the lower left from the upper right of drawing 1 .

[0027] Moreover, TFT6 of each pixel in the TFT substrate 1 The scanning line 5 and the scanning line 5 which consist of metals, such as chromium (Cr), on glass-substrate 1' of the TFT substrate 1 as shown in drawing 1 and drawing 2 , and the really cast gate electrode 8, The gate insulating layer 15 which consists of a silicon dioxide (SiO2), and the semiconductor barrier layer 14 which consists of an amorphous silicon (a-Si) etc., The up insulating layer 16 which consists of silicon nitride (SiNx), and the source electrode 9 and the drain electrode 10 which consists of the semiconductor film with which the impurity was added have reverse stagger type structure by which the laminating was carried out one by one.

[0028] And the signal line 4 which consists of the aluminum (aluminum) which connects with the

source electrode 9 through the layer insulation layers 17, such as a polyimide, is formed, further, the laminating of the layer insulation layers 18, such as a polyimide, is carried out, the pixel electrode 7 which consists of the indium tin oxide (ITO) which connects with the drain electrode 10 through opening prepared in this layer insulation layer 18 is formed, and it has the composition that the laminating of the orientation film 13 was carried out on this.

[0029] Moreover, although the driver element is set to TFT (TFT) in this example, you may use not only TFT but diode, MIM, a varistor, etc.

[0030] And the configuration of the pixel electrode 7 which is the feature portion of this example is formed so that the upper part of the signal line 4 of two sides which adjoins each other among four sides of the quadrilateral formed by two signal lines 4 and the two scanning lines 5 surrounding the pixel electrode 7, and the scanning line 5 may be covered. Here, in this example, two adjacent sides covered by the pixel electrode 7 may be two sides which make the pixel corner of the rubbing start direction an intersection. That is, as shown in drawing 1 , the pixel electrode 7 is formed so that it may lap with the upper part of signal-line 4a which adjoins the right-hand side of a pixel, and scanning-line 5a which adjoins the pixel bottom, except for a TFT portion, the line breadth of signal-line 4a and scanning-line 5a is crossed especially, line breadth is covered, and the pixel electrode 7 is extended at the lower right portion of the pixel which is the rubbing start direction, and it forms.

[0031] Especially, in this example, the soffit of the pixel electrode 7 is formed so that it may come below scanning-line 5a in drawing 1 so that the right end of the pixel electrode 7 may become on the right of signal-line 4a in drawing 1 so that the line breadth of signal-line 4a except TFT6 portion and scanning-line 5a may be completely covered by the pixel electrode 7.

[0032] Moreover, [near TFT6], the right end of the pixel electrode 7 is extended and formed to the center of the upper part of signal-line 4a, and the soffit is extended and formed to the center of the upper part of scanning-line 5a. Since TFT6 portion has a level difference, this is for preventing pixel electrode 7 adjoining comrades connecting too hastily. Similarly, the amount of [of signal-line 4a and scanning-line 5a] intersection has also prepared minute notching as shown in drawing 1 , in order to prevent pixel electrode 7 adjoining comrades connecting too hastily, since a level difference becomes large. Since this notching portion is small, the influence on a numerical aperture is small.

[0033] Here, the electric field of the active-matrix liquid crystal display of this example and the orientation of liquid crystal are explained using type section explanatory drawing of drawing 3 . The reverse tilt field to which contrast is reduced is produced by the longitudinal direction electric field between a signal line 4 or the scanning line 5, and the pixel electrode 7, and generating in a corner which corresponds in the rubbing start direction of a pixel especially is known.

[0034] Since the pixel electrode 7 is extended even to the upper part of signal-line 4a which shares the corner of the rubbing start direction, and scanning-line 5a in this example, and it forms further so that the line breadth of signal-line 4a and scanning-line 5a may be covered, The line of electric force produced in the potential difference of signal-line 4a or scanning-line 5a, and the pixel electrode 7 Since it emits from the upper surface of signal-line 4a or scanning-line 5a and is made perpendicular termination on the inferior surface of tongue of the pixel electrode 7 Contrast can be raised without being able to prevent generating of a reverse tilt field and reducing a numerical aperture by this, into liquid crystal 3, without generating lateral electric field.

[0035] Next, the manufacture method of the active-matrix liquid crystal display of this example is explained using process cross-section explanatory drawing of drawing 4 (a) - (d), and drawing 5 (e) and (f). First, on substrate 1' of the TFT substrate 1 which consists of glass, a quartz, a ceramic, etc., film deposition of the chromium (Cr) is carried out by the sputtering method, patterning is carried out by photo lithography and etching, and the gate electrode 8 and the scanning line 5 of TFT6 are formed (refer to drawing 4 (a)).

[0036] Next, SiO2 It deposits and the gate insulating layer 15 is formed. The gate insulating layer 15 functions also as insulating-layer 15' of the intersection of the scanning line 5 and a signal line 4. And the amorphous silicon (a-Si) as a semiconductor barrier layer 14 is deposited, and it is SiNx as an up insulating layer 16 on it. It deposits, and the up insulating layer 16 is formed so that patterning may be carried out by photo lithography and etching and the gate electrode 8 may be countered (refer to drawing 4 (b)).

[0037] Film deposition of the n+a-Si which moreover added the impurity is carried out, patterning of an n+a-Si layer and the a-Si layer is carried out continuously, and the source electrode 9, the drain electrode 10, and the semiconductor barrier layer 14 are formed (refer to drawing 4 (c)). In addition, in order to reduce contact resistance with a signal line 4 or the pixel electrode 7, you may prepare barrier metal, such as a tungsten (W) and titanium (Ti), in the upper part of the source electrode 9 and the drain electrode 10.

[0038] And the laminating of the layer insulation layer 17 which consists of a silicon dioxide, silicon nitride, or a polyimide is carried out, the contact hole for connecting with the layer insulation layer 17 at the source electrode 9 is formed, next film deposition of the aluminum (aluminum) is carried out, it carries out patterning, and a signal line 4 is formed. In order to prevent that the pixel electrode 7 formed on it is disconnected with the level difference of the pattern edge section of a signal line 4 by etching which forms a signal line 4, it is desirable to perform taper etching of 45 degrees or more, and to make loose the level difference by the signal line 4 (refer to drawing 4 (d)).

[0039] And film deposition of a silicon dioxide, silicon nitride, or the polyimide is carried out, the contact hole for connecting the pixel electrode 7 and the drain electrode 10 is formed, and the layer insulation layers 17 and 18 are formed. It is desirable to perform taper etching of 45 degrees or more so that ITO as a pixel electrode 7 formed in the layer insulation layer 18 upper part may carry out film deposition to a hole pars basilaris ossis occipitalis enough and may not cause an open circuit by etching of contact hole formation.

[0040] Furthermore, so that film deposition of the ITO as a pixel electrode 7 may be carried out and the area of the pixel electrode 7 may be extended to the pixel lower right portion which is the rubbing start direction on it except for a part for the intersection of signal-line 4a and scanning-line 5a Patterning is carried out so that the upper part with scanning-line 5a which adjoins signal-line 4a which adjoins the right-hand side of the pixel electrode 7 in drawing 1 , and the bottom may be covered, and the pixel electrode 7 is formed (refer to drawing 5 (e)).

[0041] And on it, a polyimide is applied, an orientation film is formed, rubbing processing is performed and the TFT substrate 1 is formed (refer to drawing 5 (f)). And between the opposite substrates 2 formed independently, restoration maintenance of the liquid crystal is carried out, it fixes, and an active-matrix liquid crystal display is formed in it.

[0042] Besides the material used by this example, moreover, as a material of the gate electrode 8 of TFT Metals other than chromium (Cr), such as aluminum (aluminum), a tantalum (Ta), and molybdenum (Mo), as a material of the gate insulating layer 15 The metallic oxide of silicon nitride (SiNx) and a gate electrode other than a silicon dioxide (SiO2) again as a material of the semiconductor barrier layer 14 Besides a-Si, CdSe, CdS and Te, PbTe, and polycrystal silicon (poly-Si) as the material of the up insulating layer 16 -- SiNx others -- SiO2 as the material of the pixel electrode 7 -- tin oxide and a zinc oxide -- as the material of the layer insulation layers 17 and 18 -- everything but a polyimide -- SiO2 and SiNx etc. -- you may use

[0043] According to the active-matrix liquid crystal display of this example, the pixel electrode 7 is extended in the rubbing start direction. Since it is made to cover the line breadth of signal-line 4a of a portion, and scanning-line 5a which forms the pixel electrode 7 in the upper part of signal-line 4a which makes the pixel corner of the rubbing start direction an intersection, and scanning-line 5a, and a

reverse tilt field tended to generate by the pixel electrode 7 Since generating of the longitudinal direction electric field in the pixel corner of the rubbing start direction leading to a reverse tilt field is suppressed and the area of the pixel electrode 7 is not reduced further, There is an effect which can prevent generating of a reverse tilt field and the fall of the contrast by it without reducing a numerical aperture.

[0044] Next, it explains, referring to drawing 6 and drawing 7 about another example concerning this example. Drawing 6 is flat-surface explanatory drawing of the active-matrix liquid crystal display of another example, and drawing 7 is type section explanatory drawing of the C-C' portion of drawing 6 . In addition, the same sign is attached and explained about the portion which takes the same composition as drawing 1 and drawing 3 .

[0045] Another active-matrix liquid crystal display of an example is extended and formed even in the center of the upper part of wiring of signal-line 4a and scanning-line 5a in which the pixel electrode 7 makes the pixel corner of the rubbing start direction an intersection with the almost same composition as the active-matrix liquid crystal display of the 1st example. It is the active-matrix liquid crystal display with which the pattern edge at the right end of the pixel electrode 7 was formed to the center of the upper part of signal-line 4a, and the pattern edge of the soffit of the pixel electrode 7 was specifically formed to the center of the upper part of scanning-line 5a.

[0046] It is made to form the edge of the pixel electrode 7 in the upper part of wiring of two sides which make an intersection the corner (here lower right) of the rubbing start direction which a reverse tilt field generates at least among the signal lines 4 and the scanning lines 5 which accomplish four sides surrounding the pixel electrode 7, i.e., signal-line 4a, and scanning-line 5a in piles. Furthermore, as shown in drawing 6 , it is also possible three sides or to pile up four sides of edges on all. The lap width of face of a signal line 4 or the scanning line 5, and the pixel electrode 7 is set to 5 micrometers or more, and if it is 10 micrometers or more, it is more desirable.

[0047] The orientation of the electric field in another example and liquid crystal is explained using drawing 7 . In the another example, at least, since the edge at the right end of the pixel electrode 7 is formed in the upper part of signal-line 4a and the edge of the soffit of the pixel electrode 7 is formed in the upper part of scanning-line 5a in drawing 6 , as shown in drawing 7 , longitudinal direction electric field occur between the pixel electrode 7, signal-line 4a, or scanning-line 5a, and the reverse tilt field which the orientation of liquid crystal reverses by it is also generated. However, since most generated reverse tilt fields are equivalent to the upper part of signal-line 4a or scanning-line 5a, it is covered by the black matrix 11 prepared in the opposite substrate 2, and can suppress the fall of the contrast of the display screen very small.

[0048] Moreover, since the crevice out of which the light of the back light arranged at the liquid crystal panel tooth back leaks and comes is almost lost when the pattern edge of the pixel electrode 7 is formed in all the wiring sections surrounding the pixel electrode 7 of four sides in piles, the formation part of the black matrix of an opposite substrate can be limited only to the pixel corner of the rubbing start direction which a reverse tilt field generates.

[0049] The inside of the signal line 4 and the scanning line 5 surrounding another active-matrix liquid crystal display ****** of an example, and the pixel electrode 7, Since the pattern edge of the pixel electrode 7 is formed even in the center of the upper part of signal-line 4a and scanning-line 5a which makes the pixel corner of the rubbing start direction an intersection in piles at least The reverse tilt field produced by the longitudinal direction electric field between a signal line 4 or the scanning line 5, and the pixel electrode 7 There is an effect which can make the bad influence to contrast small without the most serving as the upper part of signal-line 4a or scanning-line 5a, being covered by the black matrix 11 prepared in the opposite substrate 2, and spoiling a numerical aperture.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is flat-surface explanatory drawing of the active-matrix liquid crystal display concerning one example of this invention.

[Drawing 2] It is cross-section explanatory drawing of the A-A' portion of drawing 1 .

[Drawing 3] It is type section explanatory drawing of the B-B' portion of drawing 1 .

[Drawing 4] (a) - (d) is process cross-section explanatory drawing showing the manufacture method of the active-matrix liquid crystal display of this example.

[Drawing 5] (e) and (f) are process cross-section explanatory drawings showing the manufacture method of the active-matrix liquid crystal display of this example.

[Drawing 6] It is flat-surface explanatory drawing of the active-matrix liquid crystal display concerning another example of this invention.

[Drawing 7] It is type section explanatory drawing of the C-C' portion of drawing 6 .

[Drawing 8] It is flat-surface explanatory drawing of the conventional active-matrix liquid crystal display.

[Drawing 9] It is type section explanatory drawing of the D-D' portion of drawing 8 .

[Description of Notations]

1 -- TFT substrate 2 -- Opposite substrate 3 -- Liquid crystal 4 -- Signal line, [6 -- TFT 7 -- A pixel electrode, 8 -- Gate electrode,] 5 -- Scanning line [10 -- Drain electrode 11 -- Black matrix 12 -- Counterelectrode 13 -- Orientation film 14 -- Semiconductor barrier layer 15 -- Gate insulating layer 16 / 20 -- Reverse tilt field / -- 17 An up insulating layer 18 -- Layer insulation layer] 9 -- Source electrode

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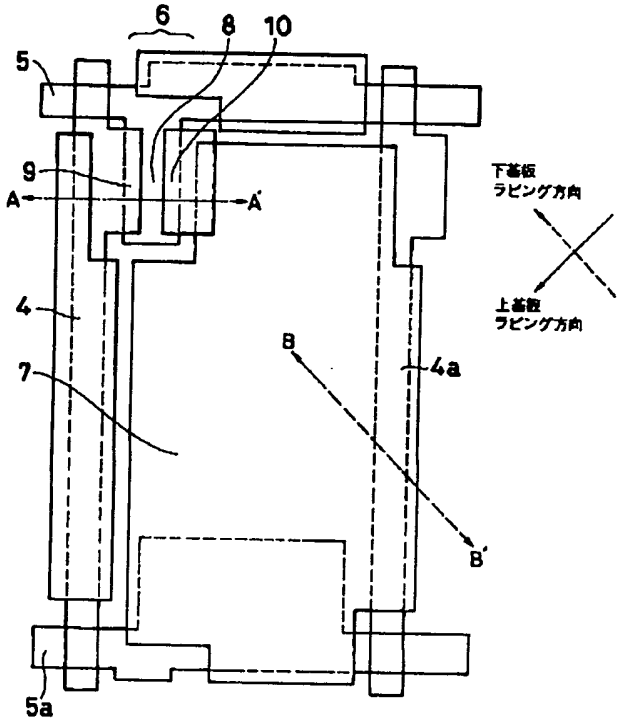
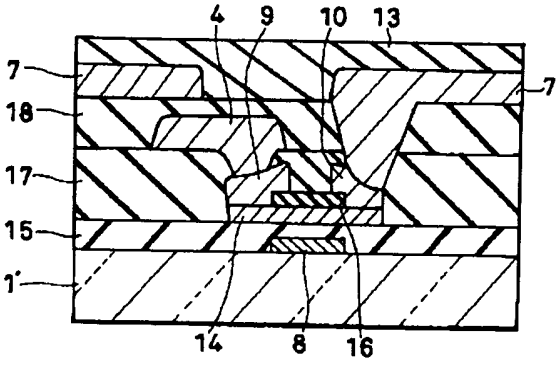
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]



[Drawing 2]



[Drawing 3]

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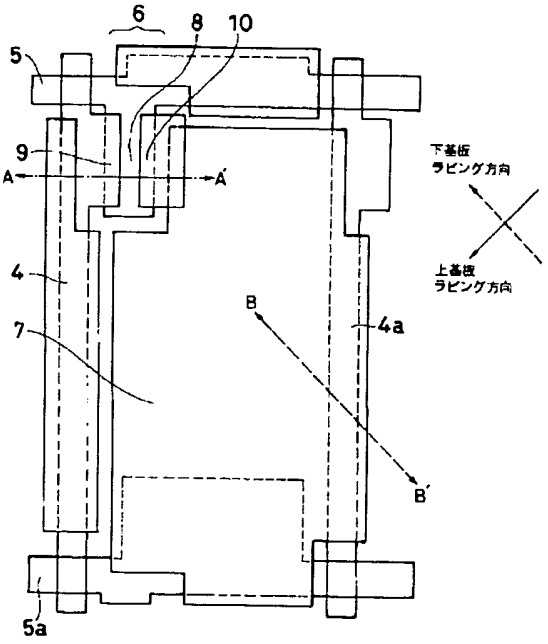
(54)【発明の名称】　アクティブマトリクス液晶表示装置

(57)【要約】

【目的】　画素電極と信号線又は走査線との間の横方向電界を防ぎ、リバースチルト領域の発生を抑えて、開口率を低下させること無く、コントラストを向上させ、また、リバースチルト領域の大部分をブラックマトリクスにより遮蔽される配線部分に発生させ、開口率を低下させること無く、コントラストを向上させることができるアクティブマトリクス液晶表示装置を提供する。

【構成】　ラビング開始方向の画素隅を交点とする信号線４ａ及び走査線５ａの上部に、絶縁層を介して線幅を横切るように画素電極７を形成したアクティブマトリクス液晶表示装置であり、また、信号線４ａ及び走査線５ａの上部に、絶縁層を介して線幅中央にまで画素電極７を形成したアクティブマトリクス液晶表示装置である。



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【特許請求の範囲】

【請求項1】　行方向に形成された複数の走査線と、列方向に形成された複数の信号線と、前記走査線と前記信号線の各交差位置に形成された駆動素子と、前記各駆動素子に接続する画素電極と、前記複数の画素電極上面に表面をラビングにより配向処理された配向膜とを有する第1の基板と、前記第1の基板の画素電極以外の部分を遮蔽する遮光層と、前記画素電極に対向する対向電極と、前記対向電極上面に表面をラビングにより配向処理された配向膜とを有する第2の基板と、前記第1の基板と前記第2の基板との間に満たされた液晶とを具備するアクティブマトリクス液晶表示装置において、前記画素電極が前記第1の基板の配向膜のラビングによる配向処理の開始方向の二辺に当たる走査線と信号線の少なくとも一方の配線の線幅を横切って覆うように絶縁層を介して形成されたことを特徴とするアクティブマトリクス液晶表示装置。

【請求項2】　行方向に形成された複数の走査線と、列方向に形成された複数の信号線と、前記走査線と前記信号線の各交差位置に形成された駆動素子と、前記各駆動素子に接続する画素電極と、前記複数の画素電極上面に表面をラビングにより配向処理された配向膜とを有する第1の基板と、前記第1の基板の画素電極以外の部分を遮蔽する遮光層と、前記画素電極に対向する対向電極と、前記対向電極上面に表面をラビングにより配向処理された配向膜とを有する第2の基板と、前記第1の基板と前記第2の基板との間に満たされた液晶とを具備するアクティブマトリクス液晶表示装置において、前記画素電極が前記第1の基板の配向膜のラビングによる配向処理の開始方向の二辺に当たる走査線と信号線の少なくとも一方の配線の一部を覆うように絶縁層を介して形成されたことを特徴とするアクティブマトリクス液晶表示装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、駆動素子として薄膜トランジスタ（Thin Film Transistor;TFT）、ダイオード、ＭＩＭ（metal/insulator/metal ）、バリスタ等を用いたアクティブマトリクス液晶表示装置に係り、特に、開口率を低下させること無く、表示画質のコントラストを向上させることができるアクティブマトリクス液晶表示装置に関する。

【0002】

【従来の技術】従来のＴＦＴ型アクティブマトリクス液晶表示装置としては、図8及び図9に示すような表示装置があった。図8は、従来のアクティブマトリクス液晶表示装置の一画素の平面説明図であり、図9は、図8のＤ－Ｄ′部分の模式断面説明図である。アクティブマトリクス液晶表示装置は、図9に示すように、ＴＦＴ基板1、対向基板2及び液晶3から構成され、ＴＦＴ基板1と対向基板2とが一定間隔で対峙し、ＴＦＴ基板1と対向基板2との間隙が液晶3で満たされている。

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【0003】ＴＦＴ基板1には、列（縦）方向の信号線4と行（横）方向の走査線5とがマトリクス状に形成され、信号線4と走査線5との各交点には駆動素子である薄膜トランジスタ（ＴＦＴ）6と、透明導電体から成る画素電極7が形成されている。そして、各ＴＦＴ6のゲート電極8は行毎に共通の走査線5に接続され、ソース電極9は列毎に共通の信号線4に接続され、ドレイン電極10は画素電極7に接続され、更に基板全体を覆うように配向膜13が形成されている。

【0004】一方、透光性基板から成る対向基板2には、下面にＴＦＴ基板1に形成されたＴＦＴ6、各配線部分及び画素電極7と各配線との隙間部分を覆うためのブラックマトリクス11が形成され、その下に共通電極である対向電極12が形成され、更に下面全体を覆うように配向膜13′が設けられている。

【0005】上記のように形成されたＴＦＴ基板1及び対向基板2は、液晶分子を基板に対して一定のプレチルト角をもって一定方向に配向させて、表示画質を均一にするために、配向膜13，13′をポリエステル等の布で一方向に擦る処理（ラビング処理）が施されている。ここでは、ＴＦＴ基板1のラビング方向を図8の右下から左上に向かう方向とし、対向基板2のラビング方向を右上から左下に向かう方向としている。そして、ＴＦＴ基板1と対向基板2とは配向膜13，13′が互いに向かい合うように保持され、その間に液晶3が満たされている。

【0006】次に、上記従来のアクティブマトリクス液晶表示装置の駆動方法について説明する。走査線5の1本に選択電圧（Vg,on）が印加されると、その走査線5に接続されているＴＦＴ6がオン状態となり、画素電極7の電位が信号線4の電位と等しくなって、信号線4に出力されているデータ電圧が画素電極7に書き込まれる。一方、対向電極12は一定電圧に保持されているため、画素電極7に書き込まれたデータ電圧と対向電極7との電位差により、間に挟まれている液晶3に垂直方向の電界が掛かり、この電界の強度に応じて液晶3の配向状態が変化し、それに伴って光透過率が変化して画像表示が行われるものである。

【0007】画素電極7に書き込まれたデータ電圧は、走査線5に次の選択電圧（Vg,on）が印加されるまでの間、つまり、非選択電圧（Vg,off ）が印加されている間は保持されるので、アクティブマトリクス液晶表示装置は、単純マトリクス液晶表示装置に比べて、高いコントラストを得ることができるものである。

【0008】しかしながら、上記従来のアクティブマトリクス液晶表示装置においては、非選択期間中に、画素電極7と信号線4との間又は画素電極7と走査線5との間に電位差を生じ、画素電極7の周辺部に横方向電界が

発生することがある。この横方向電界は、画素電極7の箇所によっては液晶分子のチルト方向を逆にする作用があり、図8に示すように、液晶分子のチルト方向が逆転したリバースチルト領域20が発生し、コントラストの低下や視覚特性の低下の一因となっていた。

【0009】ここで、リバースチルト領域（リバースチルトドメイン）20が発生するメカニズムについて図9の断面説明図を用いて具体的に説明する。TFT基板1はラビング処理されているので、画素電極7と信号線4との間に電位差がない場合は、基板近傍の液晶分子は、基板の配向膜13の配向面に対してプレチルト角θで一様に配向している。

【0010】しかし、画素電極7と信号線4との間に電位差が生じると、図9に示すように、画素電極7と信号線4とを結ぶように横方向電界が発生する。特に、TFT基板1のラビング開始方向に相当する画素電極7の端部（図8では画素電極7の右下隅部分）においては、液晶分子のチルト方向を正常な画素電極7の領域とは逆方向、すなわち－θ方向に配向させるような横方向電界が生じるために、この部分にリバースチルト領域20が発生する。リバースチルト領域20は、他の領域と光透過率が異なるために、表示画素のコントラストを低下させるという問題があった。

【0011】この問題は、アクティブマトリクス液晶表示装置特有の問題であり、駆動素子としてTFT以外のダイオード、MIM、バリスタ等を用いた場合でも同様である。

【0012】リバースチルト領域によるコントラストの低下を防止するための従来の方法は、リバースチルト領域の発生を防止する方法と、リバースチルト領域が発生してもそれを目立たなくする方法とに大別される。リバースチルト領域の発生を防止する方法としては、プレチルト角θを大きくする方法と、横方向電界の強度を小さくする方法があった。

【0013】まず、プレチルト角を大きくする方法としては、プレチルト角θが大きい液晶材料を用いる方法（澤田他，電子情報通信学会技術研究報告［電子ディスプレイ］：EID91-72,p1(1991) 参照）、プレチルト角θが大きい配向膜を用いる方法（佐谷他，National Technical Report Vol.38 No.3,p54(1992) 参照）、対向基板の対向電極をストライプ状に形成する方法（西木他,EID91-121,p35(1991)参照）、画素電極端部に傾斜を設けることにより見かけ上のチルト角を大きくする方法（特開平4－55819号公報参照）等が知られている。

【0014】また、横方向電界の強度を小さくする方法としては、画素電極7の端部を切り欠き、画素電極7と信号線4との間の距離を大きくする方法（特開平1－266512号、特公平4－49692号公報参照）、リバースチルト領域をTFTが接続している部分に重なって発生させるようにラビング方向を選択する方法（特開平3－177817号公報参照）等が知られている。後者のラビング方向を選択する方法は、逆スタガ型のTFTではドレイン電極がゲート電極にオーバーラップするために、ゲート電極上において横方向電界が小さくなることを利用したものである。

【0015】発生したリバースチルト領域を目立たなくする方法としては、リバースチルト領域を覆うようにブラックマトリクスを形成する方法（特開平1－266512号公報参照）、画素電極7の端部をブラックマトリクスの下部まで拡張し、更に画素電極7の面積拡張に対応して信号線の線幅を変形して、拡張部分にリバースチルト領域を発生させ、リバースチルト領域を覆うようにブラックマトリクスを形成する方法（特開平2－13927号公報参照）等が知られている。

【0016】

【発明が解決しようとする課題】このように、上記従来のアクティブマトリクス液晶表示装置においては、非選択時に、信号線と画素電極との間、または走査線と画素電極との間の横方向電界によって、リバースチルト領域が発生してコントラストが低下するという問題点があり、その解決策としての上記従来のプレチルト角を大きくする方法があるが、コントラスト改善にある程度の効果はあるものの、十分な効果は得られず、また、リバースチルト領域がTFT部分に重なる部分で発生するようにラビング方向を選択する方法では、TFTのドレイン電極のある部分でしかリバースチルト領域の発生を防止することができないという問題点があった。

【0017】更に、従来の別の解決策であるリバースチルト領域を目立たなくする方法としての画素電極端部を切り欠く方法や、画素電極の端を信号線の変形に対応させて拡張し、この拡張部分にリバースチルト領域を発生させ、ブラックマトリクスで覆う方法では、コントラストは改善されるものの、開口率が減少するため素子の明るさが低下するという問題点があった。

【0018】本発明は上記実情に鑑みて為されたもので、素子の開口率を減少させること無く、リバースチルト領域によるコントラストの低下を防止することのできるアクティブマトリクス液晶表示装置を提供することを目的とする。

【0019】

【課題を解決するための手段】上記従来例の問題点を解決するための請求項1記載の発明は、行方向に形成された複数の走査線と、列方向に形成された複数の信号線と、前記走査線と前記信号線の各交差位置に形成された駆動素子と、前記各駆動素子に接続する画素電極と、前記複数の画素電極上面に表面をラビングにより配向処理された配向膜とを有する第1の基板と、前記第1の基板の画素電極以外の部分を遮蔽する遮光層と、前記画素電極に対向する対向電極と、前記対向電極上面に表面をラビングにより配向処理された配向膜とを有する第2の基

板と、前記第１の基板と前記第２の基板との間に満たされた液晶とを具備するアクティブマトリクス液晶表示装置において、前記画素電極が前記第１の基板の配向膜のラビングによる配向処理の開始方向の二辺に当たる走査線と信号線の少なくとも一方の配線の線幅を横切って覆うように絶縁層を介して形成されたことを特徴としている。

【００２０】上記従来例の問題点を解決するための請求項２記載の発明は、行方向に形成された複数の走査線と、列方向に形成された複数の信号線と、前記走査線と前記信号線の各交差位置に形成された駆動素子と、前記各駆動素子に接続する画素電極と、前記複数の画素電極上面に表面をラビングにより配向処理された配向膜とを有する第１の基板と、前記第１の基板の画素電極以外の部分を遮蔽する遮光層と、前記画素電極に対向する対向電極と、前記対向電極上面に表面をラビングにより配向処理された配向膜とを有する第２の基板と、前記第１の基板と前記第２の基板との間に満たされた液晶とを具備するアクティブマトリクス液晶表示装置において、前記画素電極が前記第１の基板の配向膜のラビングによる配向処理の開始方向の二辺に当たる走査線と信号線の少なくとも一方の配線の一部を覆うように絶縁層を介して形成されたことを特徴としている。

【００２１】

【作用】請求項１記載の発明によれば、第１の基板の配向膜のラビング開始方向に当たる二辺の走査線と信号線の少なくとも一方の配線の線幅を横切って配線を覆うように絶縁層を介して画素電極が形成されたアクティブマトリクス液晶表示装置としているので、画素電極と信号線又は走査線との間で発生する電気力線は、信号線又は走査線の上面より発して画素電極のした面に垂直に終端するので、液晶内に横方向の電界を発生させることはなく、リバースチルト領域の発生を防ぐことができ、開口率を低下させることなく、表示画素のコントラストを向上させることができる。

【００２２】請求項２記載の発明によれば、第１の基板の配向膜のラビング開始方向に当たる二辺の走査線と信号線の少なくとも一方の配線の一部を覆うように絶縁層を介して画素電極が形成されたアクティブマトリクス液晶表示装置としているので、画素電極と走査線又は信号線との間における横方向電界によりリバースチルト領域が発生するが、発生するリバースチルト領域の大部分は走査線又は信号線の上部となり、第２の基板に形成された遮光層によって遮蔽されるために、表示画面への影響は極めて小いものとなり、開口率を低下させることなく、表示画素のコントラストを向上させることができる。

【００２３】

【実施例】本発明の一実施例について図面を参照しながら説明する。図１は、本発明の一実施例に係るアクティブマトリクス液晶表示装置のＴＦＴ基板側の平面説明図であり、図２は、図１のＡ－Ａ′部分の断面説明図であり、図３は、図１のＢ－Ｂ′部分の模式断面説明図である。尚、図８及び図９と同様の構成をとる部分については、同一の符号を用いて説明する。

【００２４】本実施例のアクティブマトリクス液晶表示装置は、図３に示すように、各画素の透過／不透過のオン／オフを行う薄膜トランジスタ（ＴＦＴ）及び信号線、走査線を具備する下側のＴＦＴ基板１と、ブラックマトリクス及び共通電極である対向電極を具備する上側の対向基板２と、両基板の間に挟まれて充填された液晶３とから構成されている。

【００２５】更に、具体的に本実施例のアクティブマトリクス液晶表示装置の各部について説明する。ＴＦＴ基板１のガラス基板１′の上面には、信号線４と走査線５とが絶縁層１５′を介してマトリクス状に形成され、信号線４と走査線５との各交点には駆動素子である薄膜トランジスタ（ＴＦＴ）６と、酸化インジウム・スズ（ＩＴＯ）等から成る透明導電体の画素電極７が形成されており、各ＴＦＴ６のゲート電極８は行毎に共通の走査線５に接続され、ソース電極９は列毎に共通の信号線４に接続され、ドレイン電極１０は各画素の画素電極７に接続されている。更に、上面全体を覆うように配向膜１３が形成され、図１において、右下から左上に向かってラビング処理が施されている。

【００２６】対向基板２のガラス基板２′の下面には、ＴＦＴ基板１に形成されたＴＦＴ６及び信号線４、走査線５の配線部分を覆うためのブラックマトリクス１１又はカラーフィルタ（図示せず）が形成され、その下側に対向電極１２が形成され、更に下面全体を覆うように配向膜１３′が設けられ、図１の右上から左下に向かってラビング処理が為されている。

【００２７】また、ＴＦＴ基板１における各画素のＴＦＴ６は、図１及び図２に示すように、ＴＦＴ基板１のガラス基板１′上に、クロム（Ｃｒ）等の金属から成る走査線５及び走査線５と一体成型されたゲート電極８と、二酸化ケイ素（SiO_2）から成るゲート絶縁層１５と、アモルファスシリコン（ａ－Ｓｉ）等から成る半導体活性層１４と、窒化ケイ素（ＳｉＮｘ）から成る上部絶縁層１６と、不純物が添加された半導体膜から成るソース電極９及びドレイン電極１０とが順次積層された逆スタガ型の構造となっている。

【００２８】そして、ポリイミド等の層間絶縁層１７を介してソース電極９に接続するアルミニウム（Ａｌ）から成る信号線４が形成され、更にポリイミド等の層間絶縁層１８が積層され、この層間絶縁層１８に設けられた開口部を介してドレイン電極１０に接続する酸化インジウム・スズ（ＩＴＯ）等から成る画素電極７が形成され、この上に配向膜１３が積層された構成となっている。

【００２９】また、本実施例では駆動素子をＴＦＴ（薄膜トランジスタ）としているが、ＴＦＴに限らず、ダイオード、ＭＩＭ、バリスタ等を用いても良い。

【００３０】そして、本実施例の特徴部分である画素電極７の形状は、画素電極７を囲む２本の信号線４と２本の走査線５とで形成される四辺形の４辺の内、隣り合う２辺の信号線４及び走査線５の上部を覆うように形成されている。ここで、本実施例においては、画素電極７で覆われる隣り合う２辺は、ラビング開始方向の画素隅を交点とする２辺としている。すなわち、図１に示すように、画素電極７は、画素の右側に隣接する信号線４ａと、画素の下側に隣接する走査線５ａの上部に重なるように形成され、特に、ＴＦＴ部分を除いて信号線４ａと走査線５ａの線幅を横切って線幅を覆い、ラビング開始方向である画素の右下部分に画素電極７を拡張して形成している。

【００３１】特に、本実施例では、ＴＦＴ６部分を除く信号線４ａ及び走査線５ａの線幅が画素電極７によって完全に覆われるように、画素電極７の右端は、図１において信号線４ａよりも右になるように、また、画素電極７の下端は、図１において走査線５ａよりも下になるように形成されている。

【００３２】また、ＴＦＴ６の近傍においては、画素電極７の右端を信号線４ａの上部中央まで拡張して形成し、下端を走査線５ａの上部中央まで拡張して形成している。これは、ＴＦＴ６部分が段差を有するために、隣接する画素電極７同士が短絡するのを防ぐためである。同様に、信号線４ａと走査線５ａとの交差部分も段差が大きくなるので、隣接する画素電極７同士が短絡するのを防ぐため、図１に示すような微小な切り欠きを設けている。この切り欠き部分は小さいので、開口率への影響は小さい。

【００３３】ここで、本実施例のアクティブマトリクス液晶表示装置の電界と液晶の配向について図３の模式断面説明図を用いて説明する。コントラストを低下させるリバースチルト領域は、信号線４又は走査線５と画素電極７との間の横方向電界によって生じ、特に、画素のラビング開始方向に相当する隅に発生することが知られている。

【００３４】本実施例では、画素電極７をラビング開始方向の隅を共有する信号線４ａと走査線５ａの上部にまで拡張し、更に、信号線４ａ及び走査線５ａの線幅を覆うように形成しているため、信号線４ａ又は走査線５ａと画素電極７との電位差で生ずる電気力線は、信号線４ａ又は走査線５ａの上面より発し、画素電極７の下面に垂直終端にするので、液晶３内に横方向の電界を発生させることなく、これにより、リバースチルト領域の発生を防ぐことができ、開口率を低下させること無く、コントラストを向上させることができる。

【００３５】次に、本実施例のアクティブマトリクス液晶表示装置の製造方法について、図４（ａ）～（ｄ）、図５（ｅ）（ｆ）のプロセス断面説明図を用いて説明する。まず、ガラス、石英、セラミック等から成るＴＦＴ基板１の基板１′上に、クロム（Ｃｒ）をスパッタリング法により着膜し、フォトリソグラフィー及びエッチングによりパターニングしてＴＦＴ６のゲート電極８及び走査線５を形成する（図４（ａ）参照）。

【００３６】次に、SiO_2 を堆積し、ゲート絶縁層１５を形成する。ゲート絶縁層１５は、走査線５と信号線４との交差部の絶縁層１５′としても機能するものである。そして、半導体活性層１４としてのアモルファスシリコン（ａ－Ｓｉ）を堆積し、その上に、上部絶縁層１６としてのＳｉＮｘ を堆積し、フォトリソグラフィー及びエッチングによりパターニングしてゲート電極８に対向するよう上部絶縁層１６を形成する（図４（ｂ）参照）。

【００３７】その上に、不純物を添加したｎ+ ａ－Ｓｉを着膜し、ｎ+ ａ－Ｓｉ層と、ａ－Ｓｉ層を連続してパターニングし、ソース電極９，ドレイン電極１０及び半導体活性層１４を形成する（図４（ｃ）参照）。尚、信号線４又は画素電極７とのコンタクト抵抗を低減するために、ソース電極９及びドレイン電極１０の上部にタングステン（Ｗ）、チタン（Ｔｉ）等のバリアメタルを設けても良い。

【００３８】そして、二酸化ケイ素、窒化ケイ素又はポリイミドから成る層間絶縁層１７を積層し、層間絶縁層１７にソース電極９に接続するためのコンタクトホールを形成し、次に、アルミニウム（Ａｌ）を着膜し、パターニングして、信号線４を形成する。信号線４を形成するエッチングでは、その上に形成される画素電極７が信号線４のパターンエッジ部の段差により断線するのを防止するために、４５度以上のテーパーエッチングを行い、信号線４による段差を緩くすることが望ましい（図４（ｄ）参照）。

【００３９】そして、二酸化ケイ素、窒化ケイ素又はポリイミドを着膜し、画素電極７とドレイン電極１０とを接続するためのコンタクトホールを形成して、層間絶縁層１７，１８を形成する。コンタクトホール形成のエッチングでは、層間絶縁層１８上部に形成する画素電極７としてのＩＴＯがホール底部に十分着膜して断線を起こさないように４５度以上のテーパーエッチングを行うことが好ましい。

【００４０】更にその上に、画素電極７としてのＩＴＯを着膜し、ラビング開始方向である画素右下部分に、信号線４ａと走査線５ａとの交差部分を除いて、画素電極７の面積を拡張するように、図１中で画素電極７の右側に隣接する信号線４ａと下側に隣接する走査線５ａとの上部を覆うようにパターニングして、画素電極７を形成する（図５（ｅ）参照）。

【００４１】そして、その上にポリイミドを塗布して配

向膜を形成して、ラビング処理を施し、ＴＦＴ基板１が形成される（図５（ｆ）参照）。そして、別に形成した対向基板２との間に液晶を充填保持して固定し、アクティブマトリクス液晶表示装置が形成される。

【００４２】また、本実施例で使用した材料以外にも、ＴＦＴのゲート電極８の材料としては、クロム（Ｃｒ）の他にアルミニウム（Ａｌ）、タンタル（Ｔａ）、モリブデン（Ｍｏ）等の金属を、ゲート絶縁層１５の材料としては、二酸化ケイ素（SiO_2）の他に窒化ケイ素（ＳｉＮｘ）、ゲート電極の金属酸化物を、また、半導体活性層１４の材料としては、ａ－Ｓｉの他にＣｄＳｅ，ＣｄＳ，Ｔｅ，ＰｂＴｅ，多結晶シリコン（poly-Ｓｉ）を、上部絶縁層１６の材料としてはＳｉＮｘの他にSiO_2を、画素電極７の材料としては、酸化スズ、酸化亜鉛を、層間絶縁層１７，１８の材料としては、ポリイミドの他にSiO_2、ＳｉＮｘ等を用いても良い。

【００４３】本実施例のアクティブマトリクス液晶表示装置によれば、ラビング開始方向に画素電極７を拡張し、ラビング開始方向の画素隅を交点とする信号線４ａと走査線５ａの上部に画素電極７を形成し、リバースチルト領域の発生しやすい部分の信号線４ａと走査線５ａの線幅を画素電極７によって覆うようにしているので、リバースチルト領域の原因となるラビング開始方向の画素隅における横方向電界の発生を抑制し、更に画素電極７の面積を縮小していないため、開口率を低下させること無く、リバースチルト領域の発生とそれによるコントラストの低下を防ぐことができる効果がある。

【００４４】次に、本実施例に係る別の実施例について図６、図７を参照しながら説明する。図６は、別の実施例のアクティブマトリクス液晶表示装置の平面説明図であり、図７は図６のＣ－Ｃ′部分の模式断面説明図である。尚、図１及び図３と同様の構成をとる部分については同一の符号を付して説明する。

【００４５】別の実施例のアクティブマトリクス液晶表示装置は、第１の実施例のアクティブマトリクス液晶表示装置とほぼ同様の構成で、画素電極７が、ラビング開始方向の画素隅を交点とする信号線４ａと走査線５ａの配線の上部中央にまで拡張して形成されている。具体的には、画素電極７の右端のパターンエッジが信号線４ａの上部中央まで形成され、画素電極７の下端のパターンエッジが走査線５ａの上部中央まで形成されたアクティブマトリクス液晶表示装置である。

【００４６】画素電極７を囲む４辺を成す信号線４と走査線５のうち、少なくともリバースチルト領域が発生するラビング開始方向の隅（ここでは右下）を交点とする２辺、すなわち、信号線４ａ及び走査線５ａの配線の上部に画素電極７のエッジを重ねて形成するようにしている。更に図６に示すように、３辺又は４辺全部の上にエッジを重ねることも可能である。信号線４又は走査線５と画素電極７との重なり幅は５μｍ以上としており、１０μｍ以上であればより望ましい。

【００４７】別の実施例における電界と液晶の配向について図７を用いて説明する。別の実施例では、少なくとも、図６中で画素電極７の右端のエッジを信号線４ａの上部に、画素電極７の下端のエッジを走査線５ａの上部に形成しているので、図７に示すように、画素電極７と信号線４ａ又は走査線５ａとの間に横方向電界が発生し、それによって液晶の配向が逆転するリバースチルト領域も発生する。しかし、発生したリバースチルト領域の大部分は、信号線４ａ又は走査線５ａの上部に相当するので、対向基板２に設けられたブラックマトリクス１１により遮蔽され、表示画面のコントラストの低下を極めて小さく抑えることができるものである。

【００４８】また、画素電極７を囲む４辺の配線部全てに画素電極７のパターンエッジを重ねて形成した場合は、液晶パネル背面に配置されたバックライトの光が漏れ出る隙間がほとんど無くなるため、対向基板のブラックマトリクスの形成箇所を、リバースチルト領域が発生するラビング開始方向の画素隅のみに限定することができる。

【００４９】別の実施例のアクティブマトリクス液晶表示装置よれば、画素電極７を囲む信号線４と走査線５の内、少なくとも、ラビング開始方向の画素隅を交点とする信号線４ａと走査線５ａの上部中央にまで画素電極７のパターンエッジを重ねて形成しているので、信号線４又は走査線５と画素電極７との間の横方向電界により生じるリバースチルト領域は、その大部分が信号線４ａ又は走査線５ａの上部となり、対向基板２に設けられたブラックマトリクス１１によって遮蔽されることになり、開口率を損なうこと無くコントラストへの悪影響を小さくすることができる効果がある。

【００５０】

【発明の効果】請求項１記載の発明によれば、第１の基板の配向膜のラビング開始方向に当たる二辺の走査線と信号線の少なくとも一方の配線の線幅を横切って配線を覆うように絶縁層を介して画素電極が形成されたアクティブマトリクス液晶表示装置としているので、画素電極と信号線又は走査線との間で発生する電気力線は、信号線又は走査線の上面より発して画素電極のした面に垂直に終端するので、液晶内に横方向の電界を発生させることはなく、リバースチルト領域の発生を防ぐことができ、開口率を低下させることなく、表示画素のコントラストを向上させることができる効果がある。

【００５１】請求項２記載の発明によれば、第１の基板の配向膜のラビング開始方向に当たる二辺の走査線と信号線の少なくとも一方の配線の一部を覆うように絶縁層を介して画素電極が形成されたアクティブマトリクス液晶表示装置としているので、画素電極と走査線又は信号線との間における横方向電界によりリバースチルト領域が発生するが、発生するリバースチルト領域の大部分は

走査線又は信号線の上部となり、第2の基板に形成された遮光層によって遮蔽されるために、表示画面への影響は極めて小いものとなり、開口率を低下させることなく、表示画素のコントラストを向上させることができる効果がある。

【図面の簡単な説明】

【図1】　本発明の一実施例に係るアクティブマトリクス液晶表示装置の平面説明図である。

【図2】　図1のA－A′部分の断面説明図である。

【図3】　図1のB－B′部分の模式断面説明図である。

【図4】　（a）～（d）は、本実施例のアクティブマトリクス液晶表示装置の製造方法を示すプロセス断面説明図である。

【図5】　（e）（f）は、本実施例のアクティブマトリクス液晶表示装置の製造方法を示すプロセス断面説明図である。

【図6】　本発明の別の実施例に係るアクティブマトリクス液晶表示装置の平面説明図である。

【図7】　図6のC－C′部分の模式断面説明図である。

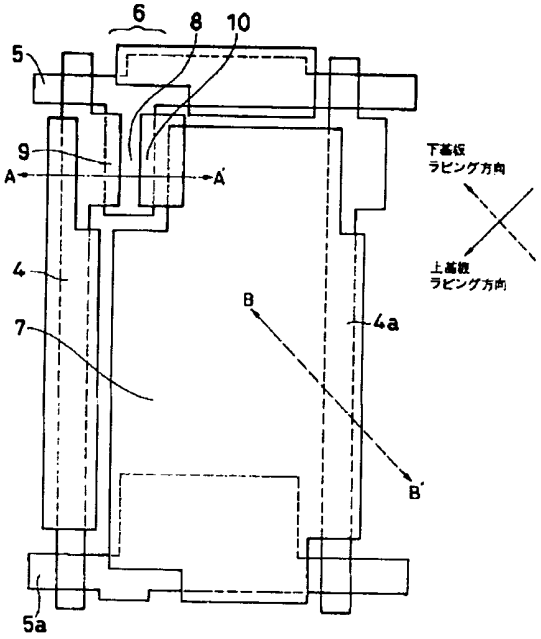
【図8】　従来のアクティブマトリクス液晶表示装置の平面説明図である。

【図9】　図8のD－D′部分の模式断面説明図である。

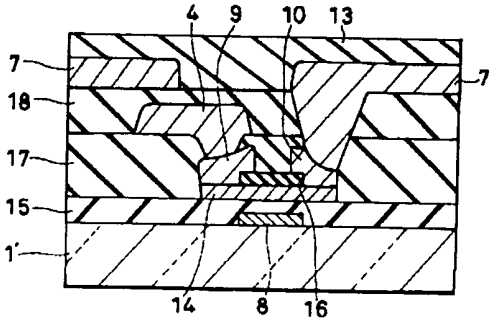
【符号の説明】

1…TFT基板、　2…対向基板、　3…液晶、　4…信号線、　5…走査線、　6…TFT、　7…画素電極、8…ゲート電極、　9…ソース電極、　10…ドレイン電極、　11…ブラックマトリクス、　12…対向電極、　13…配向膜、　14…半導体活性層、　15…ゲート絶縁層、　16…上部絶縁層、17，18…層間絶縁層、　20…リバースチルト領域

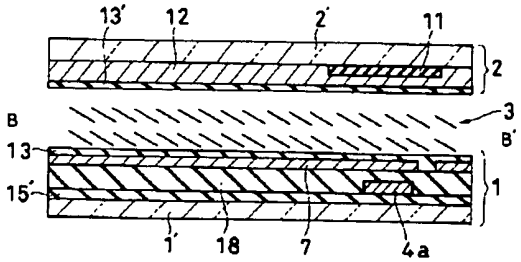
【図1】



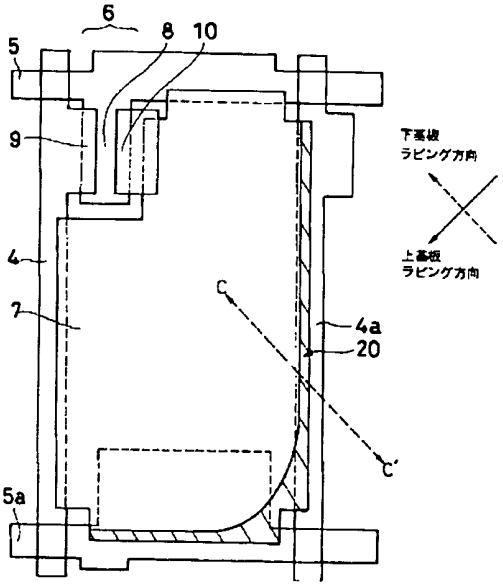
【図2】



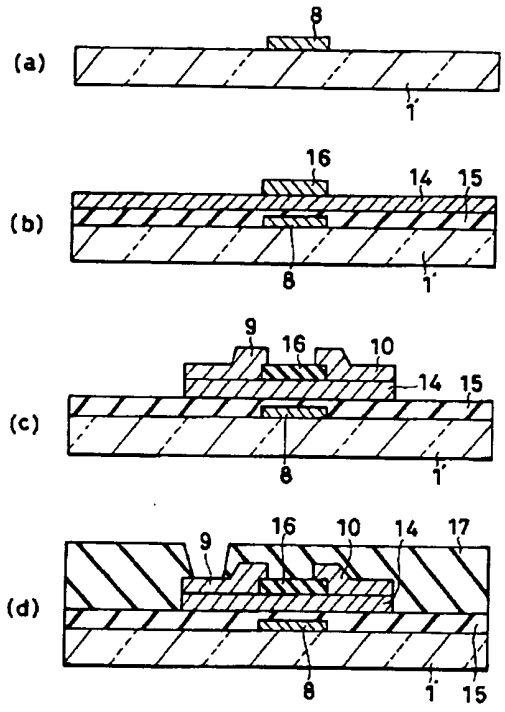
【図3】



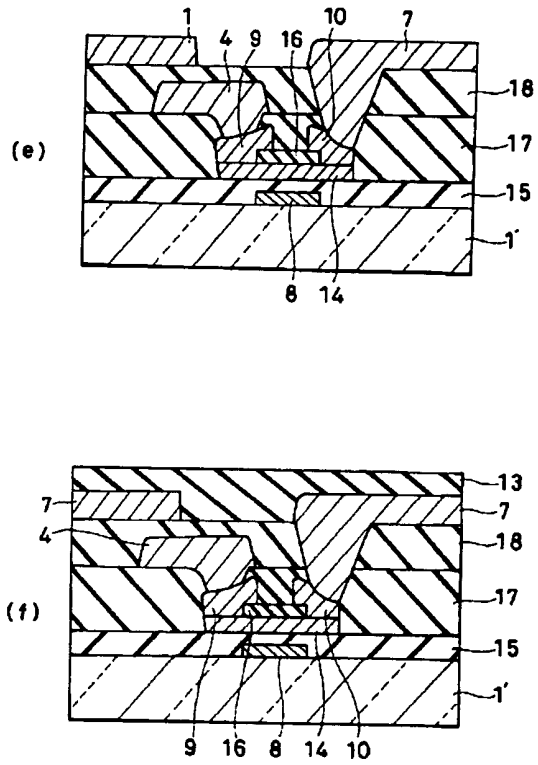
【図6】



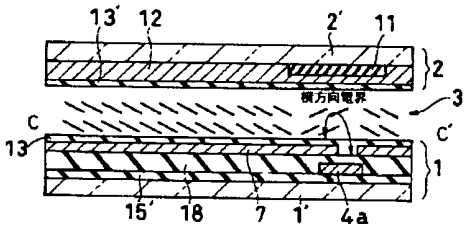
【図4】


(a)
8
1'
(b)
16
14
15
8
1'
(c)
9
16
10
14
15
8
1'
(d)
9
16
10
14
17
8
1'
15

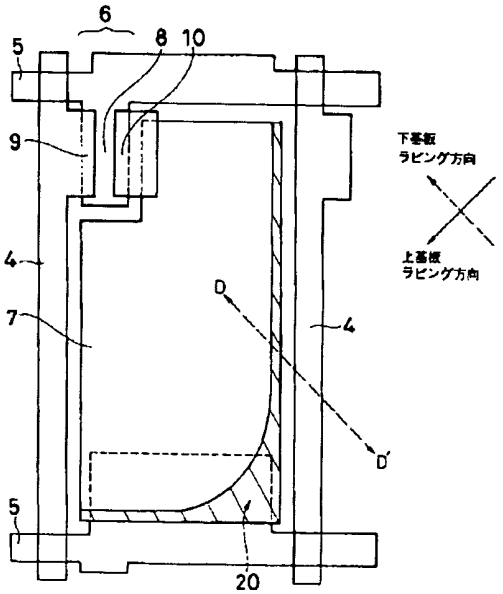
【図5】


(e)
1
4
9
16
10
7
18
17
15
1'
8
14
(f)
13
7
7
4
18
17
15
1'
9
16
8
14
10

【図7】


13'
12
2'
11
2
横方向電界
3
C
C'
13
1
15'
18
7
1'
4a

【図8】


6
5
8
10
9
4
7
D
D'
4
5
20
下基板
ラビング方向
上基板
ラビング方向

【図9】